AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

USE OF MICROCOMPUTERS IN AIR WEATHER SERVICE UNITS FOR ADMINISTRATIVE, MANAGERIAL AND TECHNICAL ACTIVITIES

MAJOR MICHAEL A. NEYLAND 84-1870

"insights into tomorrow"

DISCLAIMER

The views and conclusions expressed in this document are those of the author. They are not intended and should not be thought to represent official ideas, attitudes, or policies of any agency of the United States Government. The author has not had special access to official information or ideas and has employed only open-source material available to any writer on this subject.

This document is the property of the United States Government. It is available for distribution to the general public. A loan copy of the document may be obtained from the Air University Interlibrary Loan Service (AUL/LDEX, Maxwell AFB, Alabama, 36112) or the Defense Technical Information Center. Request must include the author's name and complete title of the study.

This document may be reproduced for use in other research reports or educational pursuits contingent upon the following stipulations:

-- Reproduction rights do not extend to any copyrighted material that may be contained in the research report.

-- All reproduced copies must contain the following credit line: "Reprinted by permission of the Air Command and Staff College."

-- All reproduced copies must contain the name(s) of the report's author(s).

-- If format modification is necessary to better serve the user's needs, adjustments may be made to this report--this authorization does not extend to copyrighted information or material. The following statement must accompany the modified document: "Adapted from Air Command and Staff Research Report (number) entitled (title) by (author) ."

-- This notice must be included with any reproduced or adapted portions of this document.

PREFACE

This report evaluates the feasibility of using microcomputer technology in Air Weather Service (AWS) units to accomplish administrative, managerial and technical functions. It also presents numerous specific applications where automation could provide benefits to the units. The report then puts forward arguments for strong centralized management of any organization-wide effort to introduce computer-based office automation into the units. Finally, the report presents recommendations for the acquisition, management and use of these systems.

This project was undertaken in an effort to validate the concept that microcomputers can make a significant contribution to the overall internal management of AWS units. Coming at a time when personally owned microcomputers are beginning to proliferate in the units, this report underscores the need to develop a master plan and policy for the acquisition, management and use of microcomputers within AWS.

ABOUT THE AUTHOR

Major Michael A. Neyland graduated from the United States Military Academy in 1971 and was commissioned in the U.S. Air Force. Assigned to Air Weather Service, he reported to the University of Utah for basic meteorology training, earning a B.S. degree in meteorology in 1972, following which he served in the Base Weather Station at Tyndall AFB, FL. There he was a forecaster, and then the chief forecaster, for the unit. In December 1973 he moved to Guam and served in the 54th Weather Reconnaissance Squadron, the Typhoon Chasers, as an Aerial Reconnaissance Weather Officer (ARWO). While there he amassed 1400 hours of WC-130 flying time, including 39 typhoon penetrations, and, with only two years of flying experience, was selected to be the ARWO Standardization/Evaluation Flight Examiner. He returned to school again in 1977, when he entered the AFIT program at Texas A and M University, earning an M.S. degree in Meteorology in 1978 as a Distinguished Graduate. For the next three years he served as the Aerospace Sciences Officer at 9th Weather Squadron, March AFB, CA, where he managed the technical activities and performance of twelve subordinate weather units. In 1981 he assumed command of the Base Weather Station at Plattsburgh AFB, NY, supporting the FB-111s and KC-135s of SAC's 380th Bombardment Wing. While at Plattsburgh AFB, he was selected as one of the Outstanding Young Men of America for 1983. Major Neyland attended Squadron Officer School in 1975 and completed the Air Command and Staff College correspondence course in 1981.

REPORT NUMBER 84-1870

TITLE USE OF MICROCOMPUTERS IN AIR WEATHER SERVICE UNITS FOR ADMINISTRATIVE, MANAGERIAL AND TECHNICAL ACTIVITIES

AUTHOR(S) MAJOR MICHAEL A. NEYLAND, USAF

FACULTY ADVISOR MAJOR CHARLES E. ZIMMER, JR., ACSC/EDCM

SPONSOR MR. GEORGE TANIGUCHI, HQ AWS/DNTS

Submitted to the faculty in partial fulfillment of requirements for graduation.

AIR COMMAND AND STAFF COLLEGE
AIR UNIVERSITY
MAXWELL AFB, AL 36112

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 84-1870	2. GOVT ACCESSION NO. AD-A144026	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* USE OF MICROCOMPUTERS IN AIR WEATHER SERVICE UNITS FOR ADMINISTRATIVE, MANAGERIAL AND TECHNICAL ACTIVITIES		5. TYPE OF REPORT & PERIOD COVERED 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Michael A. Neyland, Major, USAF, [redacted]		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS ACSC/EDCC, MAXWELL AFB AL 36112		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS ACSC/EDCC, MAXWELL AFB AL 36112		12. REPORT DATE APRIL 1984 13. NUMBER OF PAGES 39
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

STATEMENT "A"
Approved for public release;
Distribution is unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Evaluates the feasibility of using microcomputers in Air Weather Service (AWS) units for administrative, managerial and technical functions to increase unit productivity. Describes the Zenith Z-100 system. Lists possible uses of microcomputers in AWS units. Discusses the need for strong centralized management of any computer-based office automation program, including comprehensive user assistance and training. Recommends development of organizationwide office automation plan for acquisition, implementation and training.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Part of our College mission is distribution of the students' problem solving products to DoD sponsors and other interested agencies to enhance insight into contemporary, defense related issues. While the College has accepted this product as meeting academic requirements for graduation, the views and opinions expressed or implied are solely those of the author and should not be construed as carrying official sanction.

"insights into tomorrow"

REPORT NUMBER	84 - 1870
AUTHOR(S)	MAJOR MICHAEL A. NEYLAND, USAF
TITLE	USE OF MICROCOMPUTERS IN AIR WEATHER SERVICE UNITS FOR ADMINISTRATIVE, MANAGERIAL AND TECHNICAL ACTIVITIES

I. Purpose: To explore the use of microcomputers in Air Weather Service (AWS) units to automate administrative, managerial and technical functions; to suggest specific applications for microcomputers; to discuss the basic precepts of program management for any AWS microcomputer-based automation effort; finally, to describe a microcomputer system being purchased by the USAF.

II. Problem: Determine whether the use of microcomputers to automate office functions in AWS units can provide productivity and efficiency benefits to the units; determine what kinds of administrative, managerial and technical tasks can be automated; determine how such an automation program should be managed.

III. Data: AWS units, specifically base weather stations, are generally small units with fewer than 25 personnel assigned. The administrative workload for these units, however, is not significantly less than that of much larger units. A need exists to provide these unit commanders with a means to increase the productivity of their small staffs, particularly in the administrative, managerial and technical areas. Office automation through the use of microcomputer-based systems provides such a capability. Office automation efforts over the last 30 years have centered almost entirely on administrative and clerical tasks;

CONTINUED

there has been little investment in tools and techniques to help managers become more productive. Modern computer-based office technology, where it is employed, is having a big impact on managers, resulting in substantial increases in productivity. Experience to date shows these increases range from a low of 10 percent to a high of 25 percent experienced by Electronic Systems Division at Hanscom AFB, MA. The microcomputer system most likely to be used by AWS is the Zenith Z-100, of which the Air Force has contracted to procure 6000. There are a wide range of applications in the administrative, managerial and technical areas which are well suited to automation with the Z-100 system. The key to the success of any office automation project employing modern technology is strong central management of the entire program coupled with sufficient assistance to user level managers. This includes system development and procurement as well as implementation, in concert with an aggressive training program.

IV. Conclusions: Microcomputer-based office automation systems can substantially improve the productivity of workers, administrative, managerial, and technical alike. Microcomputers have many applications in AWS units, with the potential to increase productivity in the administrative, managerial and technical functions. The key to the success of any office automation effort is strong central management coupled with comprehensive user training and assistance.

V. Recommendations: AWS should establish a strong centralized management function to oversee the AWS office automation program. AWS should develop a comprehensive organizationwide plan for this program, then begin the procurement process for all units with a validated requirement. Finally, AWS should aggressively pursue the comprehensive training of all system users and the acquisition and distribution of software and applications information to all system users.

CHAPTER ONE

MICROCOMPUTERS AND OFFICE AUTOMATION: Beneficial, or Novelty?

Do microcomputers have a place in Air Force offices today? Are they novelties, just more gimmicks, or do they have the potential to significantly enhance the productivity of managers and administrators in our resource-constrained Air Force? This paper will address that question as it applies to Air Weather Service (AWS) units. It will explore first the need for, and then the use of microcomputers in AWS units, specifically base weather stations, for administrative, managerial and technical functions. This will include a discussion of centralized management of both the systems and the required training for the operators/users.

Air Weather Service base weather stations (BWS) are located at Army and Air Force installations throughout the world. The mission of these BWSs is generally to provide meteorological and staff support to specified Air Force and Army organizations, installations or functions. Although most of these AWS units are quite small (under 25 personnel), they normally are organized into three distinct functions : command and administration; staff support liaison; and weather station operations.

The command and administration section almost invariably consists of the unit commander and one administrative specialist. This one individual functions not only as the commander's receptionist and secretary, but also accomplishes most of the unit orderly room and unit administration functions.

The staff support liaison function is normally manned by one junior lieutenant. His task is to work closely with the AWS unit's customers to plan, coordinate, and implement the operational and planning weather support that those customers require.

Finally, the weather station operations section constitutes the bulk of the unit. This section, headed by a senior NCO who is the station chief, usually consists of about seven weather forecasters and either five or ten weather observers. Some units are somewhat larger while others are slightly smaller, depending on the individual unit mission.

While AWS units are usually small, the administrative workload associated with managing them is not. In fact, the administrative, training and orderly room type requirements are

virtually the same as they are for much larger Air Force organizations that have full administrative staffs. A typical AWS unit has between 25 and 50 additional duties, the same as larger organizations, but they are distributed among only 10-12 people. In addition, there are a number of technical and statistical functions unique to AWS present in each unit as well. While not particularly difficult, these functions are, nevertheless, time consuming. The cummulative result is an administrative, managerial and technical workload that stretches the unit's manpower to the limits of their capabilities. Through the use of both traditional and innovative management techniques, commanders and managers of AWS units generally provide the most effective support possible to their customers, given their manpower limitations. It is apparent that further increases in unit productivity in these areas must be the result of new methods. One such method for obtaining increases in productivity is the introduction of office automation, specifically through the means of a microcomputer.

In his treatise on office automation entitled "The Air Force Office of the 1980's, a Systems Approach," Robert Merritt described the typical AWS unit when he said :

> The Office environment within the Air Force today is largely structured along the traditional mode of 50 years ago...The inefficiencies of the traditional office organization are numerous. The most obvious is the rate of output of the secretary. Recent studies indicate that even with an electric typewriter, the average secretary still types from 50 to 60 words per minute. This is the same rate a secretary could type in 1920 on a manual typewriter. The solution to obtaining greater output in the office environment is the employment of modern office systems...(10:9)

But just what is office automation? In a 1982 report on the management of office automation, the General Accounting Office said this :

> In the late 1960s and early 1970s, the phrase "office automation" was sometimes used to refer to word processing equipment, which was developed to improve typing capability. In the late 1970s office automation was reborn as the "office of the future," combining under one banner the various components of information technologies -- word processing, data processing, and telecommunications -- and referring to the automation of functions performed by not only clerical, but professional and managerial staff as well...(9:2)

The General Services Administration was even more specific when it defined office automation as :

> ...The use of information processing technology to create, process, store, retrieve, use and communicate information to improve the performance of managerial, professional, technical or clerical tasks...The basic objective of automation is to increase office efficiency and effectiveness. (9:2)

Within this context, there are a number of practices and functions in BWSs that lend themselves to automation. The most obvious is the administrative area, including word processing, information storage and retrieval, as well as many orderly room functions. In the management area, supply, budget, training and scheduling all appear to be likely candidates for automation. In addition, there are a number of technical functions unique to AWS units which can be simplified or done more efficiently with a microcomputer. The following chapters explore all of these possibilities, beginning with a description of the microcomputer system most likely to be used.

CHAPTER TWO

THE SYSTEM: Zenith Z-100

In October 1983 the Air Force announced the award of a contract to Zenith Data Systems Corporation to supply up to 6,000 microcomputer systems to the Air Force, with an option for additional units in the future. With this action, the Air Force embarked on an effort to make microcomputers readily available to organizations with valiuated requirements, while at the same time attempting to introduce some standardization of equipment to the rapidly growing Air Force inventory of small computers. The system selected was the Zenith Z-100, the most advanced desktop computer offered by Zenith. (11) (The system description and specifications were all drawn from Zenith sales and promotional material.)

SYSTEM SPECIFICATIONS

The Zenith Z-100 system is an advanced microcomputer that is flexible and expandable, with a relatively large memory capacity, dual disk drives, color or monochrome video, graphics, dot matrix or letter quality printer, and a large variety of software. The specifications of the system are discussed below.

Hardware Configuration

The Z-100 comes in two basic configurations. The all-in-one model incorporates the computer, keyboard, two 5 1/4" floppy disk drives, and a 12 inch green monochrome video monitor, all in the same cabinet. The monitor displays 25 lines of 80 characters or 225 lines of 640 dots. The low profile model includes everything but the video monitor. Both systems can be upgraded to drive color video monitors. Available with the system are several printers, including an 80 characters per second (cps) dot matrix, a 120cps dot matrix with graphics capability, and a Diablo 630 letter quality printer. The Diablo includes tractor feed, 10 and 12 pitch and OCR print wheels. Other hardware options include telephone modems and a Houston Instruments graphics plotter. The Z-100 system operates on 120/240 volts and 50/60 Hz at 400 watts maximum. The temperature operating range is 60 to 90 deg F.

CPU and Memory

The Z-100 has dual microprocessors that allow both 8-bit and 16-bit software to be run on the computer. Operating system software utilized is either CP/M or ZDOS (from Microsoft). The internal memory (dynamic RAM) is 128K bytes standard and is expandable to 768K bytes. The dual 5 1/4 inch floppy disc drives are double-sided, double density, 320K bytes per drive. Also available are a single Winchester 5 1/4 inch rigid disc, which provides 11.3 megabytes of storage, as well as 8 inch floppy disc drives. In addition, in 1984 Zenith will introduce a multi-user DOS that will enable up to eight remote terminals to run off the CPU of one Z-100.

Software

In addition to the CP/M or ZDOS operating system, the Z-100 is compatible with several other languages as well. Software compilers, in both 8 and 16-bit, are available for Basic, Pascal, Fortran, Cobol and an assembly language, Macro. Several word processing packages are available, including Wordstar and Peachtext, as well as their related spelling proofreaders. Other word processing packages, like Datastar, provide the capability to create forms and then enter, retrieve, update and maintain data according to the requirements of the forms created. Zenith also provides a Data Base Management System, Condor rDBMS, that includes data base files indexing and full report writing capabilities. There are also two spreadsheet packages available, Multiplan and SuperCalc. Finally, there is a rapidly growing myriad of software packages available commercially that can satisfy almost any requirement, as well as the AWS-unique software that is being created to accomplish specific functions. The following chapter will address those various tasks and functions in a BWS that are likely to benefit from the introduction of microcomputers.

CHAPTER THREE

AUTOMATION : What Can it Do?

The question that arises most often is what can office automation in the form of a microcomputer do for the typical BWS. Although there are literally hundreds of tasks or procedures that are susceptible to automation, the bottom line is this: increase productivity and efficiency. The advent of modern office technology has had a substantial impact on administrative or clerical work, principally through the use of word processing. Such has not been the case with managers and professionals, however. As John J. Connell, founder and executive director of Office Technology Research Group, said:

> One would be hardpressed to find any essential changes in the way managers operate today compared with 30 years ago. Capital investment to date in tools and techniques to help managers become more productive is negligible. (2:59)

OFFICE AUTOMATION IN THE BUSINESS WORLD

The potential impact of modern office technologies on managers was analyzed in a major study recently completed by Booz-Allen and Hamilton, a well-known business consulting firm. Their key finding was this : The first and biggest effect of new technology on managers was saving time. The ultimate payoff, however, was not in time per se, but the value of new duties. The time saved allowed managers to perform better and to take on additional work. Net result was an increase in productivity. (2:59) Harvey L. Poppel, a senior vice-president at Booz-Allen and Hamilton, indicated that US business spends only $1200 per year for information technology (including telephone service) for the average manager or professional, compared to $5000 per year for the average clerical worker. Poppel's studies show that an average initial investment of only $7500 per professional for equipment, training and installation would produce a time savings of $25,000 per professional over the first five years. He concluded that within five years these workers could save an average of 15 percent of their time through automation. (3:68-69)

Relatively few companies are working hard on improving office productivity now, according to the American Productivity Center in Houston. However, those that are doing so have scored

significant gains, detailed in a recently completed study of 99 companies titled "White Collar Productivity : The National Challenge." Citing the study, C. Jackson Grayson, Chairman of the Center, said that "companies with in-place office productivity efforts show an average gain of 9.5 percent in effectiveness and efficiency." (6:35) SRI International, a research firm in Menlo Park CA, says the number of electronic work stations "will top the number of electric typewriters in offices by the end of the decade." They say the introduction of this kind of electronic technology into offices will pay off in a 14 percent time savings for managers and an even more significant 25 percent savings for professionals. (6:34-35) David L. Terrie, senior office systems analyst at International Data Corporation, a leading market research firm, claims that only about 3 percent of all professional, technical, managerial and administrative workers use the new small computer technologies. He predicts that figure will climb to 65 percent by 1990. (3:68) Such tremendous savings are already being realized at some places, such as Hanscom AFB MA. There a system was installed to keep track of $3 billion worth of bids solicited for electronic systems. Lt Gen James W. Stansberry, commander of Electronic Systems Division (ESD), reported that the result was a 25 percent improvement in the productivity of the ESD staff. (3:69) Wang Laboratories of Lowell MA, the leader in the sales of word processing equipment, is straight forward about the merits of automation. They said that "electronic office equipment produces a direct cost saving...[by] freeing up space and human resources through a reduction in manual effort." Equally important, said John F. Cunningham, Wang's executive vice president of field operations, are indirect benefits, such as more effective decision making by management. (1:49) David Kearns, president of Xerox Corporation, appears to have expressed the consensus view of the business world when he said, "Generating efficiencies in the office can be done effectively only by putting office automation into the hands of professional people." (5:66) The remainder of this chapter will address the specific applications of automation in the BWS.

AUTOMATION IN THE BASE WEATHER STATION

The three principal areas where the application of microcomputers to BWS operations is to be explored are the administrative, managerial and technical activities which are common to most AWS units. The lists of tasks or functions in each area represent specific procedures that are possible candidates for automation. The list is certainly not all-inclusive, nor is it desirable to automate all the functions which are included. Indeed, in many cases, it may be more efficient or cost effective to continue to perform a procedure or practice by the current non-automated method. If so, this information is also included. Many of the specific tasks listed here were drawn in whole or in part from a 7 April 1982 HQ AWS/DNTS letter on the subject (8),

while some ideas were drawn from an article by David Mcfarlane and adapted to the BWS environment (4).

Administrative Function

The first function is the area of unit administration, which represents the most conventional application of office automation. Consequently, this is also the area that is likely to realize the most immediate gain in productivity, due primarily to the addition of word processing capability.

Word Processing. This may well be the single greatest time saving benefit to be realized from automation. (Although the cumulative time savings derived from the various tasks in the management area will most likely be greater, no one single task will be.) A word processor/text editor capability enables the typist to almost completely eliminate retyping of documents. Combined with a spelling corrector and the multi-user DOS for remote terminals tied to the central microcomputer, everyone with access to a terminal can prepare or edit their own drafts with the system. Preparation of final copies of documents by the typist is then a simple matter. Below are just some examples of the types of documents that are particularly well suited for word processing technology :

a. SOPs, DOIs, OPLANs and OPORDs.

b. Checklists--duty shift, emergency action, contingency, deployment, inspection, quality control, etc.

c. Recurring correspondence and form letters, such as sponsor letters and mobility assignment notification letters.

d. Awards and decorations.

e. OERs and APRs.

f. Duty schedules.

g. AWS MIS report.

h. Unit file plan.

Electronic Messages. Messages can be either stored for an individual or routed to a specific remote terminal. Clerk or anyone with access to a terminal can enter messages into the system; replaces memo routing slips.

Electronic Calendar. Use to schedule meetings, briefings, appointments, key suspenses, reminders, etc. Link to message system to inform individuals of events or changes on calendar.

Master Suspense File. Record all unit suspenses. Then be able to sort by name, function, day, week, month, etc. Everything in the unit with a suspense could be put in this file.

Forms and Publications Management. The requisition and tracking of forms ar publications could be greatly simplified.

Civilian Time Sheets. With only one or two civilians, this task would probably be done more efficiently manually. However, with a larger civilian work force, time and attendance reporting is a good candidate for automation.

Leave Management Program. Track all the various suspenses and maintain current leave balances; manage leave scheduling.

Electronic Mail. Perhaps one of the most useful aspects of this type of system. When connected to other addressees, either by telephone modem or a local area net, the units can transmit correspondence to each other in real time.

Management Function

This next major area includes many management related tasks, procedures and topics. Although some of them may appear to be administrative tasks in their specifics, their purpose is to permit the unit's managers to more effectively conduct their business; hence, they are listed as management functions.

Personnel Files. Key management data could be stored on every individual, such as standard AF personnel system data, education, PME, UGT status, experience levels, additional duties, etc. Data could then be sorted and retrieved by any of the individual data parameters. For example, the same data base would support sorts to show training program status and requirements, mobility team member status, etc.

Suspense Files. Specific applications include self-inspection program suspenses, training requirements and scheduling. Could be used as a project control log, showing tasked individual, project milestones, both achieved and future, and overall project status.

Budget and Supply Management. Use to supplement the computer products received from base supply and the comptroller. Use to show budget analysis and projections, using graphics capability. For supply, keep track of inventory and rate of consumption, project future requirements; support with graphics.

Duty Schedules. Simplifies creation and modification of complex rotating shift duty schedules. Allows schedule modelling based on various personnel availability rates. Finished schedule can be printed without further retyping.

Forecast Verification Program. Significant enhancement of current capabilities is possible here, particularly in the realm of analysis.

a. Forecast verification. Computation of scores is easily automated, and it then becomes feasible to compute verification scores by unit, forecaster, week, month, weather event, category, or any other criterion. Then a quantitative analysis may be applied, not only to the scores, but to trends, comparisons, or seasonal behavior. It is also possible to analyze amendment and intermittent group performance, as well as specific weather parameters, such as wind, precipitation occurrence or types, and the like. With the system's inherent graphics capabilities, the results of these analyses may then be displayed visually as well.

b. Weather warnings and metwatch advisories. The very same type of rigorous analysis may then be applied to verification of warnings and advisories. This data base then also provides the input to the AWS Form 16 for compiling weather warning verification statistics.

Graphics Capability. The system will produce three-dimensional graphics, with the capability to upgrade to color graphics. With a printer with graphics capability, all the graphics can be produced in hard copy as well. This means that charts and graphs can be produced from practically any data base in the computer, from supply consumption rates to personnel experience levels. In addition to their value as analysis tools, these graphics represent an excellant source of briefing slides and materials.

Technical Library Management. Build a complete inventory of the unit's technical library contents. Couple this with abstracts of each work or publication. A related and useful tool would be an index by subject of all SOPs, DOIs and technical library material.

AWS Management Information System Report. Use to collect data and compile report. Then use to analyze results, identify trends, make projections, etc.

Climatological Support. There are many things that can be done in this area. Some are feasible and very desirable, while others are neither practical nor possible on a system of this size.

a. Local climatology summaries. Use to compile and print local monthly climo summaries. Then compute daily cumulative totals (year, month, week-to-date, etc.) of all parameters, such as heating/cooling degree days, precipitation, thunderstorm days, etc. Compare to normal and extreme values. Use graphics to display.

b. Solar and lunar data. Use to store or compute solar, lunar and twilight data for any desired location or day. Quickly produce hard copies for any location for mobility kits.

c. Other uses. It is also possible to store unit RUSSWOs and conditional climatology tables, as well as airfield climatology summaries, although most of these documents are currently available on microfiche. Once the data are stored in a computer system, it would then be possible to manipulate them, specifically to update the climatological data. Because of the size of the data base involved, this process would be very cumbersome, and is not suited to this type of system. Other similar, but impractical, uses might involve manipulating portions of this climatological data base to calculate the probabilities of occurrence of non-standard categories of different weather elements.

Quality Control Program. Use to compile data, print statistical portions of reports, conduct analyses of unit performance, identify trends. Can be analyzed by individual or by product, etc.

Training Program Management. Use to track training requirements, schedule training, and provide documentation. Every one of the many training programs present in the typical BWS could be managed with this system. Training requirements and scheduled events could be integrated into the master suspense file, the *electronic calendar and the electronic messaging system.* Some of the types of training management that could be incorporated into the system include:

a. OJT, including upgrade, qualification and continuation training, particularly metsat, radar and computer training.

b. Contingency training, including mobility, chemical warfare and small arms training.

c. Unit follow-on-training program.

d. Ancillary training and general military training (GMT) subjects, as well as the junior officer training program.

e. Weight management program.

Computer-Assisted Instruction (CAI). The system can be used to provide CAI in topics ranging from operation of the computer system, to encoding weather observations, to computing toxic corridor information.

Unit Career Advisor Program. Use to track all career advisor suspenses when coupled with the personnel data base. Monitor CJR and reenlistment status of personnel.

Miscellaneous Uses. While all these applications are possible, most of them are not practical, since it is probably more efficient to do these tasks manually.

a. Store data for monthly reports and activity letters, such as exercises, inspection results, significant events, etc.

b. Keep flying schedules up to date. If connected to the supported unit scheduling activity by modem or local area net, then real time flying schedule updates are possible.

c. Use for workload and manpower data compilation, analysis and computation.

d. Use to keep track of the status of mobility personnel and equipment.

e. Use to keep track of status of meteorological and communications equipment. Could be used as an equipment outage log.

Technical Function

The last major group of applications to be examined is the technical activities list. It is important to note that this system will not overlap any of the functions of the Automated Weather Distribution System (AWDS). As a result, there may be many more possible applications which have not been considered because they conflict with AWDS. Additionally, many of the functions listed below may be possible but not practical, the automated procedure requiring more effort than the benefit derived warrants.

Forecast Studies. This system gives units the ability to apply a rigorous scientific and mathematical treatment to the many forecast studies that are present in AWS units. The system will allow the units to conduct statistical examinations of data, do correlations, regressions and curve fitting, as well as deal with much larger amounts of data than was previously possible.

Skew-T Diagram. Use to plot and analyze multiple upper air soundings. Analyze for any desired parameter, such as stability indices, compare to previous soundings, etc.

Radar Program. Use to calculate radar return intensities, conduct radar bore sighting computations, conduct portions of operators' performance checks. Use to plot digital or conventional radar reports.

Temperature and Pressure Altitude. Use to plot actual versus climatological temperature/pressure altitude curves, make temperature forecasts using solar insolation, continuity, etc.

Psychrometric/Barometric Calculations. Use to replace the observer's circular slide rule for making psychrometric calculations. Use for the altimetry/barometry program to replace manual tables and computations.

Flight Weather Briefings. Use to compute pressure altitude, pressure altitude variation and D-values for high and low level routes, ranges and targets. Store field elevation and runway heading for all desired airfields.

Miscellaneous Forecasting Functions. Listed below are a number of uses that are within the capability of the system; however, some of them are inappropriate or impractical within the context of the purpose of this system.

a. Assist in making probability forecasts.

b. List statistical forecast aids.

c. Run MOS forecast equations locally using AFGWC or USAFETAC derived equations and coefficients.

d. Assist in making icing and turbulence forecasts using standard AWS flow charts and upper air sounding data.

e. Compute geostrophic wind.

f. Produce graphic displays of ceiling and visibility categories, including past and forecast weather conditions.

g. Analytically reconstruct weather conditions for forecast reviews.

h. Tendency calculations for various parameters, such as pressure and temperature.

i. Wind structure data. Use to do PIBAL computations and build upper air wind profiles using sounding data.

j. Ballistic meteorology computations for Army support.

k. Decode and display various types of bulletins.

l. These next applications, although possible, are probably not practical or desirable; some of them also conflict with AWDS.

(1) Use as a forecast preparation worksheet.

(2) Use as a forecaster or observer shift duty checklist, including a prompting device.

(3) Use as an alerting device for amendment, warning or advisory criteria, or alert for special conditions which would invoke the use of local rules of thumb, etc.

(4) Use to perform a checkerboard metwatch.

(5) Log PMSV contacts.

(6) Prepare briefing flimsies, either for individual missions or for large scale or repetitive flight operations.

(7) Pass weather information to other agencies on base.

Computation of Miscellaneous Products or Parameters. There are a large number of computational functions that can be automated. Some of them, however, will not yield improved efficiency through automation. Some examples of both kinds are listed below.

a. Toxic corridor computations, coupled with graphic display of the results.

b. Electro-optical weapons system support. Use to store contrast values as well as make all related calculations. Results can be displayed graphically.

c. Fall out forecasts, chemical warfare diffusion and conventional atmospheric diffusion forecasts can be produced, accompanied by graphic representations as well.

d. Anomalous propagation and atmospheric refraction forecasts.

e. Crosswind component determination. Use to compute range of expected crosswind component. Use graphics and stored critical crosswind thresholds for various aircraft and meteorological conditions.

f. Manipulation of FOUS forecast data.

g. Probability of lightning conditions calculations and forecasts.

h. Calculations of results of local numerical rules.

i. Wet globe temperature calculations for Army support or runway-shelter height temperature difference determinations for F-16 support.

j. Simple conversions, which are possible, but do not increase efficiency, such as manual runway visual range distance conversions, Fahrenheit to Celsius conversions, and equivalent wind chill temperature determinations.

CHAPTER FOUR

PROGRAM MANAGEMENT : The Case for Strong Centralized Management

Once the decision is made to venture into the world of electronic office automation, a number of peripheral issues and questions arise. One of the more important is the question of management of the office automation program. This includes such diverse issues as requirements analysis and validation, acquisition, program guidance, training, and applications. Because these factors can play such a significant role in the overall effectiveness of any new system, it is very easy to build a good case for strong centralized management of any office automation program. This chapter will begin by examining that case in general, and then address some of the specific issues involved in the context of an AWS office automation program.

THE GENERAL ACCOUNTING OFFICE REPORT

More than 80 percent of the Federal work force are white collar workers - clerical, technical, professional and managerial - most of whom are office bound and whose work involves information creation and processing. (9:1) It is not surprising, then, that Federal government agencies plan to spend hundreds of millions of dollars in the next few years on office automation to boost worker productivity. With this in mind, the General Accounting Office (GAO) reviewed office automation efforts and plans in the Federal government, and published their results in a 1982 report entitled "Strong Central Management of Office Automation Will Boost Productivity." The GAO studied automation programs in four government agencies (Departments of Labor and Navy, Forest Service and NASA) and in four large private firms that had successful automation programs. The findings contained in the report are significant and warrant careful consideration by any organization undertaking an automation program. In his cover letter transmitting the report to the United States Senate, Charles A. Bowsher, the Comptroller General, said, "Although office automation has the potential to improve Federal productivity, if inadequately managed, it may waste rather than save scarce resources." (9) (The remainder of this section is drawn almost entirely from the GAO report; references to it will not be cited individually.)

The GAO report begins by recognizing that properly used office automation could produce a significant savings or increase

in productivity in the Federal work force, but that there are several barriers to be overcome. They cite, as an example, the government's earlier experiences with individual applications of ADP and word processing and the demonstrated serious problems in the planning, acquisition, management and use of those systems, as well as the hundreds of millions of dollars that were unnecessarily spent.

The experiences of the large private firms that have successfully implemented office automation, on the other hand, indicate that strong central management of the program is the key to success, giving specific attention to:

1. Adequate management of systems development and implementation;

2. Sufficient assistance to user level managers.

These companies felt that the lack of strong central management would result in office automation systems that:

1. Would not be adequately evaluated and, therefore, not be cost effective;

2. Would not be properly procured and might be incompatible with existing systems;

3. Would be independently developed and might duplicate existing systems.

The GAO found that in the four Federal agencies reviewed, management of office automation was fragmented and weak. Without the necessary strong central management, the four agencies were beginning to encounter many of the very problems that the successful private firms sought to avoid. In particular, the agencies had not met any of the three elements discussed below, all of which were considered by the private firms to be important to successfully developing and implementing office automation:

1. Establish organizationwide plans for managing the development and implementation of office automation. The private firms had learned through experience that organizationwide plans could help:

   a. Identify the areas with the greatest opportunity for productivity improvement through automation;

   b. Prevent the duplication of office automation efforts;

   c. Preclude the development of uncoordinated individual plans and strategies.

The Department of Labor, for example, found itself with many pieces of office automation equipment that were not compatible with each other because the agency lacked a coordinated plan. The GAO predicts that this situation will recur in countless other Federal agencies if they cannot develop organizationwide plans for managing office automation.

2. Conduct economic analyses to insure that the procurement and use of systems is cost effective. Economic analyses are important to insure that office automation systems are procured and used cost effectively. Consequently, the cost analyses should be performed both before systems are procured (normally feasibility studies or requirements validations) and after they are installed. The post-installation analyses are important to insure productivity gains have been realized and identify excess equipment or areas of under-usage.

3. Provide technical, managerial and human resource assistance to help user-level managers develop and operate systems. The experience of the successful private firms showed that it was very useful to possess an in-house capability to provide assistance in these three areas:

a. Technical assistance to aid in keeping abreast of changing technologies, evaluating equipment capabilities and assuring that any equipment being considered is compatible with existing equipment. This last item is particularly crucial for integrated office automation systems.

b. Managerial assistance for evaluating the feasibility, cost effectiveness and productivity potential of new systems.

c. Human resources assistance for obtaining operator acceptance of new technology, designing workplaces that will reduce hazards and discomfort, and conducting training programs.

In the GAO review of Federal agencies, user-level managers consistently identified the lack of all three types of assistance as major barriers to obtaining the best results from office automation. Without organizational expertise in office automation, user-level agencies are forced to rely much too heavily on consultants, equipment vendors, or the organizations' own personnel, who may have only limited experience with office automation systems. A good example is the concern expressed by agency managers over the lack of adequate training for both the professionals and the support staff that would be using the systems. For instance, at the NASA Ames Research Center, an office automation system was acquired for administrative, professional and managerial staff; however, very few of those people made use of the system because most did not understand how to use it. In addition, they could not obtain training because at NASA training

on office automation equipment was not available from a central source.

One final tenet that the GAO report underscores again is the need for centralized management. The report shows that any organization pursuing an office automation project needs to place responsibility for office automation in a single group to insure consistent and comprehensive management, particularly in the face of rapidly changing technology. The role of this group includes at least these specific functions:

1. Establishing guidance and procedures covering procurement and use of systems;

2. Developing plans and strategies for applications;

3. Disseminating the results of office automation projects;

4. Insuring the availability of technical and managerial assistance to users.

The GAO has built a powerful case for strong centralized management of office automation projects. The next step is to apply some of the principles delineated by the GAO to AWS and specifically to the use of office automation (microcomputers) in base weather stations.

AWS PROGRAM MANAGEMENT

AWS finds itself today in the situation shared by many other Federal agencies and private firms alike. With no centrally managed office automation program in existence, individual units have begun to acquire microcomputers by any means possible. As a result, there currently is no commonality and no compatability of either hardware or software from unit to unit, except by accident. THE BEST WAY TO BRING THIS HEADLONG RUSH INTO MODERN TECHNOLOGY UNDER CONTROL AND GIVE IT DIRECTION IS TO ESTABLISH STRONG CENTRALIZED MANAGEMENT OF THE ENTIRE PROGRAM, FROM ACQUISITION TO TRAINING AND APPLICATIONS. Specifically, AWS must carefully consider each of these elements:

1. Establish an organizationwide plan for managing the development and implementation of the program;

2. Conduct economic analyses to insure that the procurement and use of systems is cost effective;

3. Provide technical, managerial and human resource assistance to help user-level managers develop and operate systems. Specifically, be able to provide assistance in these areas:

a. Technical assistance to aid in keeping abreast of changing technologies, evaluating equipment capabilities, and insuring that any equipment being considered is compatible with existing equipment;

b. Managerial assistance for evaluating the feasibility, cost effectiveness and productivity potential of new systems;

c. Human resources assistance for obtaining operator acceptance of new technology, designing workplaces that will reduce hazards and discomfort, and conducting training programs.

In addition, the AWS central management group should be able to provide assistance to all system users in the following areas:

1. Establish guidance and procedures covering procurement and use of systems;

2. Develop plans and strategies for applications;

3. Disseminate the results of office automation projects to other users;

4. Insure the availability of technical and managerial assistance to users.

The most important task currently facing AWS is to develop an organizationwide plan. That plan should cover acquisition, applications, system/user support and training. It is not the purpose of this paper to develop such a plan ; however, a brief discussion of some of the pertinent elements is appropriate.

Overall Program Guidance and Direction

It is important to determine what direction the AWS office automation program is going to take. This includes such things as determining what types of units should be involved and the scope of the automation effort (i.e., integrated office systems, microcomputers, or just word processing capability). This guidance should be made available to the field as soon as it is developed.

Acquisition Policy

This important decision must be made and the policy disseminated quickly. The logical goal is to achieve commonality and compatibility throughout the command. This goal is now attainable, due to the Air Force small computer contract that was let in October 1983, if firm guidance is provided to the field to

prevent the independent acquisition of systems not compatible with the Zenith Z-100. System compatibility throughout the command is essential if the potential productivity and cost effectiveness gains are to be realized. For example, the cost of software development, procurement and maintenance will increase tremendously if AWS must support more than one type of system.

System Applications

AWS must initially provide not only definitive guidance on specific applications of the systems, but must be able to provide assistance, as well, to insure that the users can effectively employ their systems. (Specific applications are addressed in Chapter III). Once the systems gain user acceptance, a new role emerges, that of an information clearinghouse. AWS must be able to solicit, validate and crossfeed information, ideas, applications and software throughout the command.

Program Management

A central office of responsibility should be established at AWS that would manage the entire AWS program. Counterpart points of contact and expertise should exist at all subordinate levels as well, such as in the wing and squadron aerospace sciences/technical services functions. At the unit level, a program monitor should be appointed as the single point of contact, similar to the radar and metsat program coordinators. Even though the systems would be used to perform tasks within the operations (DO), aerospace sciences (DN) and administrative (DA) functional areas, it is important to maintain control by not fragmenting management of the program. A management group comprised of members from each functional area is acceptable as long as strong centralized control and responsibility are maintained.

Software Management

One of the key responsibilities of the program managers will be software. This will include acquisition, development, solicitation, validation and dissemination. Initially it will be both necessary and desirable to commercially procure software, specifically such things as word processing, spread sheet, files management and data base management packages. There are also a number of software packages available that cater to the unique needs of the field of meteorology. Within a short time of the deployment of the systems, it is likely that the system management group will begin to receive mission-unique requirements for software from field units. Consequently, it will be necessary to have the ability within AWS (HQ AWS, AFGWC or USAFETAC) to respond to these requirements by developing (or procuring) the appropriate software. A major source of software will almost

certainly be AWS personnel themselves. Software, either finished or conceptual, should be solicited from all the users of the system, with the provision that it must be validated (by a designated individual or group) before it can be distributed or used. It then becomes absolutely essential to expedite the validation process to avoid smothering or diverting the creative efforts of personnel in the field units. The wing and squadron level aerospace sciences personnel could potentially play a large role in this process. The final element is dissemination. An excellent vehicle already exists for the dissemination of software or applications ideas; that is the AWS Operations Digest.

What has been presented above is simply a cursory discussion of some of the many factors that must be addressed in order to assure a strong, well managed, and productive office automation program in AWS. One element, however, is missing from this discussion. That element is the subject of training.

Training Program

Perhaps the single most important aspect of any office automation project is training. As Michael Thoryn wrote in a special report titled "The Office Computer Boom : It's Just Beginning" in Nation's Business :

> *Proper selection and installation of office electronics equipment, a difficult task in itself, does not assure higher productivity. Workers have to learn to use the equipment properly.* (6:35)

Although many AWS units have personnel assigned who are computer literate to varying degrees, this is no substitute for formal training. The example cited earlier from the GAO report involving the new office automation system at NASA's Ames Research Center attests to the necessity for a formal training program.

The training for AWS users should come in several phases. The first phase should be mass, one-time training as the systems are delivered to the units. The best approach to this task is most likely the ATC mobile training team (MTT) concept, such as was employed in AWS to teach satellite meteorology shortly after the widespread acquisition of GOES capability. In fact, ATC has developed such a training program to support Air Force small computer acquisitions (HQ ATC/TTY 292300Z Nov 83 msg, subj: Microcomputer/Small Computer Training).

The ATC program consists of the elements indicated below, specifically tailored to any one of three microcomputer systems, including the Zenith Z-100. (7:1-2)

1. A five day mobile training course directed at functional users. This course will address, as a minimum, introduction to

microcomputers, use of operating system and utilities, instruction on use of application packages (e.g., word processing, financial spreadsheet, data base management) and basic programming. Other topics planned for inclusion are reasons for files backup, system recovery techniques, security management, etc.

2. A video production of very basic instruction (e.g., how to turn on the machine, right and wrong ways of loading diskettes, diskette maintenance, simple explanation of hardware components and how they interact, etc.).

3. Exportable training packages delivered on floppy disks for microcomputer applications.

This training is scheduled similar to most other ATC formal training courses. Training requirements must be submitted IAW the procedures contained in AF Regulation 50-9.

Because of the large numbers involved in the small computer acquisition program, it is likely that there will be many systems purchased at any given base. Hence, the requirement for an MTT visit to each base may help alleviate the initial training load. It is not likely, however, that this method will be satisfactory for the bulk of the training required by AWS units. Other approaches are necessary as well. One of these is to add the computer training to the curriculum of the weather courses taught at Chanute AFB. This material would be appropriate for courses such as the forecaster, station chief and weather staff officer courses, as well as the radar and satellite courses. In addition, this type of training could be added to the curriculum requirements of both the AFIT basic weather officer and advanced academic degree programs.

The final type of training that should be explored is that of follow-on or continuation training at the user level in the units. This type of training could take many forms, ranging from interactive computer-assisted instruction (CAI) to sound/slide ISD format self-instruction programs for the Caramate system, to simple, printed information packages. Whatever form it takes, it is essential to have a program that provides for periodic refresher or update training at the user level. This training would complement the efforts of the unit computer coordinator, helping him to deal effectively with both the growth in software/applications as well as the continuous turn-over of personnel.

The responsibility for acquiring these training packages would reside with the AWS small computer management group. Much of the training material will be available from ATC, some from commercial sources, and AWS will probably have to develop some independently. Regardless of the source, however, the importance of a sound and comprehensive training program cannot be overstated, for it is only after the users are trained and

comfortable with the system that worker productivity and effectiveness benefits will begin to be realized.

In summary, office automation, like any other tool, has the potential to improve the effectiveness of those using it. Like other tools, this one also must be properly employed in order to work as it should. There are many different elements involved in properly and effectively building and using an office automation system, ranging from acquisition strategy to user training. One factor emerges as key, however, to the success of any office automation project. That key is strong central management.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. Office automation systems, including microcomputers, when properly employed and managed, can substantially improve the productivity of workers, administrative, managerial, professional and technical alike. The single largest savings comes in terms of time saved.

2. Office automation systems, specifically microcomputers, have many applications throughout AWS in the administrative, managerial, and technical functional areas. The potential exists to increase productivity and generate significant time savings in these areas.

3. The key to the success of any office automation project is strong central management coupled with an organizationwide plan which includes, among many other elements, substantial and continuing assistance to users of the systems.

4. A sound and comprehensive user training program is essential if the system is to gain user acceptance and enable the increases in worker productivity and effectiveness that are possible.

RECOMMENDATIONS

1. AWS should establish a strong centralized management function to oversee the entire AWS office automation program.

2. AWS should develop a comprehensive, organizationwide plan for office automation. The acquisition strategy/policy portion of the plan should be completed and implemented as soon as possible to preclude the further spread of piece-meal acquisitions that will not be compatible with the system to be selected by AWS.

3. AWS should procure, or authorize the procurement of, office automation systems, such as the Zenith Z-100 microcomputer, for use in those AWS units with a validated need.

4. AWS should aggressively pursue the comprehensive training of all users of any AWS office automation system.

5. AWS should actively pursue the acquisition, development, validation and distribution of software and applications information to all AWS office automation system users.

BIBLIOGRAPHY

A. REFERENCES CITED

Articles and Periodicals

1. "America's Offices Enter a New Age," Nation's Business, Vol. 69, No. 7 (July 1981): pp. 49-54.

2. Connell, John J. "Managing the Electronic Office," Nation's Business, Vol. 70, No. 2 (February 1982): pp. 59-62.

3. "How Computers Remake the Manager's Job," Business Week, 25 April 1983, pp. 68-70.

4. Mcfarlane, David. "100 Ways to Automate Your Office," Datamation, Vol. 28, No. 11 (October 1982): pp. 145-152.

5. Schatz, Willie. "A Terminal on Every Desk?" Nation's Business, Vol. 70, No. 2 (February 1982): pp. 64-69.

6. Thoryn, Michael. "The Office Computer Boom: It's Just Beginning," Nation's Business, Vol. 70, No. 12 (December 1982): pp. 34-36.

Official Documents

7. U.S. Department of the Air Force: HQ Air Training Command (TTY). "Microcomputer/Small Computer Training," message. Randolph AFB, TX, 29 November 1983.

8. U.S. Department of the Air Force: HQ Air Weather Service (DNTS). "Small Computer Inventory and Future Requirememts," letter. Scott AFB, IL, 7 April 1982.

9. U.S. Government: Office of the Comptroller General (General Accounting Office). Strong Central Management of Office Automation Will Boost Productivity. Washington, DC: Government Printing Office, 21 September 1982.

CONTINUED

Unpublished Material

10. Merritt, Robert K., Maj, USAF. "The Air Force Office of the 1980s, A Systems Approach." Research study prepared at the Air Command and Staff College, Air University, Maxwell AFB, AL, May 1977.

Other Sources

11. Zenith Data Systems. "Zenith Z-100 Series, The Business Solution," maufacturer's information brochures, 1982.

B. RELATED SOURCES

Books

Covvey, H. Dominic and Neil Harding McAlister. Computer Consciousness: Surviving the Automated 80s. Reading, MA: Addison - Wesley Publishing Company, 1980.

Fuori, William M. and Dominick Tedesco. Introduction to Information Processing. Englewood Cliffs, NJ: Prentice - Hall, Inc., 1983.

Lientz, Bennet P. An Introduction to Distributed Systems. Reading, MA: Addison - Wesley Publishing Company, 1981.

Sippl, Charles J. and Roger J. Sippl. Computer Dictionary and Handbook. Indianapolis, IN: Howard W. Sams and Company, Inc., 1980.

Articles and Periodicals

Byron, Christopher. "Fighting the Paper Chase," Time, Vol. 118, No. 21 (23 November 1981): pp. 66-67.

CONTINUED

Meinel, Carolyn. "Computer Graphics on Every Desk?" Technology Review, Vol. 85, No. 7 (October 1982): pp. 74-75.

Nauges, Louis. "Office Automation Alibis," Datamation, Vol. 29, No. 11 (November 1983): pp. 233-238.

Salmans, Sandra. "The Debate Over the Electronic Office," The New York Times Magazine, 14 November 1982, pp. 132-158.

Schatz, Willie. "New Conquests for the Computer," Nation's Business, Vol. 70, No. 6 (June 1982): pp. 67-76.

Spindle, Les. "Computerizing Your Office," Radio-Electronics, Vol. 54, No.1 (January 1983): pp. 82-84.

_____. "Electronic Worksheets for Your Computer," Radio-Electronics, Vol. 53, No. 9 (September 1982): pp. 80-108.

Spinrad, R.J. "Office Automation," Science, Vol. 215, No. 4534 (12 February 1982): pp. 808-812.

Taylor, Alexander. "Small-Computer Shootout," Time, Vol. 117, No. 9 (2 March 1981): pp. 68-69.

Veit, Stanley S. "How a Small Computer Can Help Your Business," Nation's Business, Vol. 70, No. 6 (June 1982): pp. 78-80.

Warren, Carl. "Notes on Using Your System as a Secretary," Computers and Electronics, Vol. 20, No. 11 (November 1982): pp. 108-109.

Official Documents

Shavelson, Richard J. and John D. Winkler. Can Implementation of Computers be Justified on Cost-Effectiveness Grounds? Rand Paper No. P-6781. Santa Monica, CA: The Rand Corporation, June 1982.

CONTINUED

U.S. Department of the Air Force: Air Force Audit Agency. Small Computer Acquisition and Management. Report of Audit No. 805540. Andrews AFB, Washington DC: Directorate of Service-Wide Systems, 6 May 1981.

U.S. Department of the Air Force: Air Force Communications Command. Consolidated Information Services Planning Document. Volume IV, Base-Level Functional Plans. Gunter AFS, AL: Air Force Data Systems Design Center, 1 August 1983.

Williges, Beverly H. and Robert C. Williges. User Considerations in Computer-Based Information Systems. Blacksburg, VA: Virginia Polytechnic Institute and State University, September 1981.

Unpublished Materials

Brown, Robert H., Lt Col, USAF and Jack A. Riess, Jr., Maj, USAF. "Small Computers and Management Decisions." Paper presented at 1983 Air University Airpower Symposium, Maxwell AFB, AL, 28 February 1983.

Fowle, Bernard H., IV, Maj, USAF. "Some General Applications for Low-Cost Computers for the Tactical Fighter Squadron." Research study prepared at the Fighter Weapons School, Nellis AFB, NV, August 1980.

Good, Roy C., Maj, USAF. "Management of Tactical Air Command Information Technology." Research study prepared at the Air Command and Staff College, Air University, Maxwell AFB, AL, May 1979.

Other Sources

Duffield, George F., Lt Col, USAF. HQ Air Weather Service (DNTS), Scott AFB, IL. Personal communication, 12 September 1983.

von Flotow, Charles S., Maj, USAF. HQ Air Weather Service (DOOX), Scott AFB, IL. Interview, 26 October 1983.